

SECURITY MESSENGER SYSTEM

This application claims the benefit of U.S. Provisional Application No. 60/404,388, filed August 20, 2002, the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of Invention

This invention relates generally to secure mobile data, video and voice communications. More specifically, this invention relates to intra-vehicle as well as inter-vehicle communications and communications with a designated operations center.

2. Description of Related Art

Air security has been a major concern in recent times. For many years, the Federal Aviation Administration (FAA) has implemented the Federal Air Marshal (FAM) program that places air marshals on U.S. air carriers. The FAM program serves as a deterrent to hijacking and other forms of terrorists activity aboard in-flight aircrafts. The program provides a covert, armed security force capable of conducting anti-hijacking operations and of deploying rapidly. FAMs are specially trained Special Agents who travel on U.S. air carriers routes and areas where worldwide terrorists activities might occur. FAMs are authorized to carry firearms and, if they reasonably believe that a person has or is committing a felony, FAMs can make arrests without a warrant for any offense against the U.S. However, once in flight, the FAMs have no means of communication capability. Accordingly, FAMs need a non-obtrusive communication device that has a clear channel communication with an operations center which may be on the ground and/or airborne. The communication device should allow text messages, discernable graphics and voice transmissions. The device should be able to transmit and receive an image from an operations center. The device should also have the ability to control mounted surveillance cameras, view the camera image and send the image to an operations center. In an extremis situation, the device should activate a tracking device that can only be turned off by encryption from a geographic different source. The device should allow global communications.

SUMMARY OF THE INVENTION

The object of this invention is to provide a communication system that integrates all the required applications of data, video and voice communications onto a single

device and then transmit the data/graphics/voice portion over an existing data network when appropriate.

The communication system, according to the invention provides a control and display unit, such as a portable handheld pocket PC or Personal Digital Assistant (PDA), an aircraft mounted integrated Global Positioning System (GPS) satellite receiver, aVHF radio modem or Iridium satellite modem, an Aircraft Communication and Reporting System (ACARS) transceiver and a backup battery for power.

This invention provides systems and methods for sending data messages in flight or on the ground.

This invention separately provides systems and methods for sending voice communications in the aircraft or on the ground.

This invention separately provides systems and methods for displaying, transmitting and/or receiving real time video or still graphics in flight or on the ground.

This invention separately provides systems and methods for communicating as a cell-phone mode when on the ground.

In various exemplary embodiments of the systems and methods according to this invention, the data link can be transmitted as messages. For example, data link messages can be communicated to other Sky Marshals on board, to ground based terminals, such as ground operations center, to other Sky Marshals on other flights, to iDEN handhelds on airport surface, and/or to the pilot on board by the ACARS terminal.

In various exemplary embodiments of the systems and methods according to this invention, data link can be transmitted in a form of a custom message set that is encrypted.

In various exemplary embodiments of the systems and methods according to this invention, the voice communications mode can be sent to other Sky Marshals onboard the flight. In additional embodiments, the voice communication mode may be connected to a land-based phone line, to iDEN handhelds, to the pilot of the aircraft, to the pilot of another aircraft, and/or to other Sky Marshals on other flights.

In various exemplary embodiments of the systems and methods according to this invention, the video mode can be used to display, transmit and/or receive video signal. For example, the video mode can display streaming video, interface to an onboard camera system and select video frames to data link to the ground operations center.

In various exemplary embodiments of the systems and methods according to this invention, the cellular phone mode can be established using cell phone technology when

not airborne. As an exemplary embodiments, the cell phone technology can be a Global System for Mobile communications (GSM) and/or General Packet Radio Service (GPRS) technologies to allow users to access the Internet, send and receive emails and Short Message Services (SMS) messages and communicate using the inherent voice capabilities of the cell phone technology, such as, but not limited to CDMA, FDMA, TDMA and PSTN.

In a further various exemplary embodiments of the systems and methods according to this invention, the video mode can interface to and control onboard peripheral devices, such as, for example, cameras in the cockpit or cabin of the aircraft.

In a further various exemplary embodiments of the systems and methods according to this invention, the crew of the aircraft may activate a panic button in the cockpit to transmit a signal that there is a situation to the ground operations center and/or Sky Marshals. Another exemplary embodiment according to this invention includes a portable remote panic button. The remote panic button also transmits a signal to the ground operations center and/or Sky Marshals.

In various exemplary embodiments of the systems and methods according to this invention, this system provides an Emergency Broadcast Message.

In various exemplary embodiments of the systems and methods according to this invention, this system provides a low cost intrusion security system because the system is already integrated over an existing infrastructure and commercial products for communications, distributions and situation awareness, such as the Aircraft Communications Addressing and Reporting System (ACARS) data network. In yet another exemplary embodiment, the system may be integrate with SAT/COM capability.

In various exemplary embodiments of the systems and methods according to this invention, this system provides administrative functions to back office applications, such as scheduling, gate assignments, cabin inventory, cargo inventory, reservations and passenger data base.

In various exemplary embodiments of the systems and methods according to this invention, the input sensors can interface to and monitor onboard devices, such as, for example, physical panic buttons that can be used by the air crew to alert FAM of threat conditions.

These and other features and advantages of this invention are described in, or are apparent from, the following detailed description of various exemplary embodiments of the system and apparatus according to this invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Various exemplary embodiments of the system and apparatus according to this invention will be described in detail, with reference to the following figures, wherein:

Figure 1 illustrates the various communication functions of one exemplary embodiment of a communication system according to this invention;

Figure 2 illustrates a communication system of one exemplary embodiment according to this invention;

Figure 3 illustrates in greater detail the components of the communication apparatus according to an exemplary embodiment of the invention;

Figure 4 illustrates the communication networks for the data and voice networks according to an exemplary embodiment of the invention;

Figure 5 illustrates the communication system components according to an exemplary embodiment of the invention; and

Figure 6 illustrates the various content applications for the system according to an exemplary embodiment of the invention.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

Fig. 1 illustrates various communication capability of one exemplary embodiment of a communication system according to this invention. The communication system provides a control and display unit 100, such as a Secure 802.11 or Bluetooth, that integrates all the required applications of data communication 110, video communication 120, voice communication 130 and cell phone communication 140 onto a single device.

In an exemplary embodiments of the systems and methods according to this invention, a data link can be transmitted as messages while in flight. The data message 110 can be communicated to other Federal Air Marshall (FAM) on board the aircraft, to ground based terminals, such as ground operations center, to other FAMs on other flights, to iDEN handhelds on airport surface, and/or to the pilot on board the aircraft.

Moreover, the data link messages can be in a form of a custom message set that is encrypted. The message can only be encrypted by the ground operations center.

The data communication 110 is transmitted over a near real-time data link communications over an existing network, such as the Aircraft Communications Addressing and Reporting System (ACARS) from ARINC, Incorporated. ACARS is used in airline operational control and, increasingly, air traffic control communications

around the world. ACARS uses various data link technologies including the VHF communication band, HF and SATCOM along a ground station network to allow the aircraft to transmit and receive the data link messages. Many domestic and international carriers have equipped their aircrafts with the ACARS system, thus, the cost of implementing the present system over the ACARS system will be cost effective and highly reliable. The ACARS system also provides high reliability and message delivery assurance as well as 24/7/365 real time monitoring of the system. In an exemplary embodiments of the systems and methods according to this invention, the voice communications 120 mode can be transmitted to other Sky Marshals onboard the flight. Further, the voice communication mode may be connected to a land-based phone line, to iDEN handhelds, to the pilot of the aircraft, to the pilot of another aircraft, and/or to other Sky Marshals on other flights.

Further, the voice communication 120 mode may also perform as a two-way voice communication apparatus accomplished over an existing ARINC Air/Ground Domestic (AGD) network using VHF voice radio capability. The ARINC operated AGD network is an Aviation communications service that is provided to aircrafts flying over North America. The ARINC AGD network includes over 110 ground based VHF and HF transceiver sites which are monitored by ARINC radio operators constantly. The AGD network radio operators act as intermediaries to connect airborne aircraft to any facility that they need to contact on the ground. Conversely, radio operators can also connect ground based calling parties to aircraft while airborne. Also, by utilizing automation technology in the ARINC ground based control system, airborne aircraft's can directly connect to ground based circuits without radio operator intervention should the airborne equipment be capable of tone generation. A FAM can use this voice network to establish direct voice communications with any ground based telephone network including the control or operations center.

Further, the voice communication 120 mode may also perform as a wireless communication voice-over Internet Protocol (VoIP) technology. In VoIP applications, voice signals are digitized and packetized at a sending end, transmitted via the Internet in a digital format to a receiving end where they are converted into analog voice signals.

In another exemplary embodiments of the systems and methods according to this invention, the video communication 130 mode can be used to display, transmit and/or receive video signal. For example, the video mode can display streaming video, select video frames to data link to the ground operations center and interface to a multiple

onboard camera system. The multiple onboard cameras can transmit real time video to the control and display unit 100 as streaming video images and/or still video images wirelessly, whereby the Sky Marshals may transmit the video signals to the ground operations center. Further, the Sky Marshals can remotely control/interface with the cameras and affect the movements and functions of the cameras.

In another exemplary embodiment of the systems and methods according to this invention, the communication 130 mode can perform a tracking display function in real time. For example, the FAMs have the capability to receive ACARS messages on a device which include position report messages that can display a geographical representation or map of the location of the aircraft. This capability provides the FAM a mechanism to monitor the actual current position of the aircraft which provides situational awareness. The device is also capable of receiving positional information concerning other aircraft in the vicinity of their position which also provides enhanced situational awareness.

In an exemplary embodiments of the systems and methods according to this invention, the cellular phone communication 140 mode can be established using cell phone technology when not in flight. For example, the technology can be Global System for Mobile communications (GSM) and/or General Packet Radio Service (GPRS) technologies to allow users to access the Internet, send and receive emails and Short Message Services (SMS) messages. Moreover, the systems and methods of this invention also provide for receipt and display of facsimile information.

Fig. 2 illustrates a communication system 10 of one exemplary embodiment of the systems and methods according to this invention. As shown in Fig. 2, the communication system 10 includes a receiver for a wireless access device 200, ACARS transceiver system 300, very high frequency (VHF) and Global Position System (GPS) antenna 400, SATCOM antenna 500, security sensor interface 600 and peripheral device 700.

The transceiver 200 can transmit, for example, by a 802.11x access point. The data link may be encrypted, as an exemplary embodiment of the systems and methods according to this invention, by implementing a V-ONE security data link. Under certain conditions, the receiver 200 can transmit a vehicle position at a programmed interval for tracking and which can only be turned off by encrypted command from a ground operations center. Once a special condition is initiated by the flight crew or by the FAM, the onboard system will begin transmitting ACARS messages to appropriate

ground based control centers at a programmed time interval (typically 30 seconds). Due to the covert nature of the installed system hardware, the position report transmissions cannot be stopped by any physical means when the aircraft is airborne or by any command entered into the system from airborne equipment. Only a message or command entered at a valid ground based control or operations center can terminate the automatic transmissions of position reports from an airborne system. This capability eliminates the possibility of airborne disarming the system intentionally or unintentionally.

The ACARS transceiver system 300 incorporates a VHF radio modem and Iridium SATCOM modem that uses ACARS data. One exemplary embodiment in ACARS functionality includes airborne capabilities, such as, for example, but not limited to, the airborne capability to transmit weather requests (ATIS, TAF, METAR), graphic weather information, text messages, PDC requests, position reports (including, for example, autonomous tracking information), estimates, delays and special/emergency conditions, and to perform GPS Spoofing. Another exemplary embodiment in ACARS functionality includes automated messages capability. For example, but not limited to, the automated messages capability implements Out, Off, On, In (OOOI) and security intrusions. Yet, another exemplary embodiment in ACARS functionality includes ground based capabilities. For example, but not limited to, the ground based capability implements graphic display of aircraft position, web-based messaging and ARINC 24/7 monitoring and backup. The pocket PC and or PDA devices have the ability and capacity to store and archive all data communicated. This includes data transmitted as well as data received. The operator has the ability to review archived data and select messages to retransmit or to be used as templates to generate new messages. The device databases are ultimately downloaded to ground based systems for archiving, analysis and reporting.

The ACARS transceiver system 300 can also switch to voice mode that enables communications to existing ARINC Air/Ground Domestic Communications (AGD) network. The AGD network provides for emergency communications over 110 VHF sites located throughout North America. The ARINC operated AGD network is an Aviation communications service provided to aircraft flying over North America. The ARINC AGD network includes over 110 ground based VHF and HF transceiver sites which are monitored by ARINC radio operators constantly. The AGD network radio operators act as intermediaries to connect airborne aircraft to any facility that they need

to contact on the ground. Conversely, radio operators can also connect ground based calling parties to aircraft while airborne. Also, by utilizing automation technology in the ARINC ground based control system, airborne aircrafts can directly connect to ground based circuits without radio operator intervention should the airborne equipment be capable of tone generation. A FAM can use this voice network to establish direct voice communications with any ground based telephone network including the control or operations center.

The ACARS transceiver system 300 provides control to signal voice or data connectivity that converts the digital audio to analog for voice communication. The digital voice signal is generated by the pocket PC or PDA device using VoIP technology and communicates or transmits the digital voice packets to other FAM devices as well as to the ACARS transceiver which converts the digital voice packets to analog in order to transmit the voice over the ARINC AGD network. Conversely, analog voice received to the ACARS transceiver is converted to digital VoIP, and relayed to FAM pocket PC or PDA devices.

The VHF and GPS antenna 400, as shown in Fig. 2 is a direct air-ground and ground-air digital communications mode by means of a VHF sub-network. The SATCOM antenna 500, as shown in Fig. 2 is an indirect air-ground and ground-air digital communication mode by means of a sub-network of telecommunication satellites. The ACARS transceiver 300 implements, at the choice of the pilot of the aircraft to choose between antenna 400 or antenna 500 depending on the telecommunications network coverage. If the VHF antenna 400 does not operate at a specific coverage area, then the SATCOM antenna 500 will replace the VHF antenna 400 as its coverage. Among the parameters influencing the pilot's choice of features includes cost, performance and security of the communications, as well as the availability of the transmission equipment on board the aircraft and on the ground in the coverage area. It should be appreciated that the ACARS digital telecommunications network is implemented throughout the world on behalf of the airlines by various operators who offer ground-to-ground, air-to-air, in aircraft, and ground-to-air coverage.

The security sensor interface 600, as shown in Fig. 2 serves as a security server. The security sensor interface 600 has a security sensor input. The input sensors can interface to and monitor to onboard devices, such as, for example, physical panic buttons that can be used by the air crew to alert FAM of threat conditions and to other signal generating devices, such as fire or smoke detectors which would enable the system to

send automatic ACARS messages to appropriate ground based systems should certain events occur. The system will also transmit to appropriate onboard FAMs on their pocket PC or PDA devices in the event of and sensor detected input.

The ACARS transceiver 300 can be connected to a peripheral device 700, such as, for example, as an exemplary embodiment, one or more video cameras. The peripheral device(s) 700 can be placed anywhere in the aircraft that is possible including, for example, in the cockpit of the aircraft or the cabin of the aircraft to be monitored by the video camera(s) and controlled by a Sky Marshal using a portable, e.g., hand-held, computer. The hand-held computer of the Sky Marshal interfaces with the peripheral device 700 and the communications systems and methods according to this invention to operate the movements and functions of the peripheral device 700. Further, a computer device of the Sky Marshal can be used to display streaming video or select video frames that are captured by a video camera to be transmitted, for example, to the operations center. In other words, the peripheral device 700 may be used to transmit real time video feed to the control and display unit 100 of the Sky Marshal wirelessly, to permit a Sky Marshal to transmits streaming and/or still video image signals to the operations center.

It should be appreciated that in various exemplary embodiments, these elements, while shown in Fig. 2 as separate elements, are not necessarily separate and distinct components. Thus, the functions and/or operations of any one or more of these elements may be carried out by a single device, structure and/or subsystem.

Fig. 3 illustrates the detailed various components of the ACARS transceiver 300. The ACARS transceiver 300 includes a ACARS control unit 301, GPS unit 302, modem & control unit 303, and 12 sensor port 304 that communicates with a singular or with multiple control & display units (CDU) 100 and to other pocket PC or PDA devices. The ACARS transceiver 300 is integrated into a single enclosure, and houses an ACARS control unit (ACU) which includes a processor and memory for program instructions and data storage on a single circuit board. The ACU is the main processing unit of the ACARS transceiver unit. The ACU controls all peripherals and provides the necessary encapsulation of data into the ACARS protocol and format. The ACU also generates the special condition and event messages to transmit via the modem to the ground based systems or to CDU and pocket PC and PDA devices onboard the aircraft. The ACU also manages the communications connectivity by determining appropriate media to be used for communications (per coverage).

The integrated modem provides the ACU data to the VHF or Satcom based transmitters in appropriate format and characteristics. The modem also receives data (ACARS messages) from VHF or Satcom channels and provides the data to ACU for necessary processing and distribution.

The integrated GPS device provides the ACU real-time position and time information. This information is used by the ACU to determine appropriate communication frequencies based on geographic coordinates and appropriate spatial coverage, provides position information used in ACARS position report messages, provides positional information used for situation display capability of FAM pocket PC or PDA devices when positional information is superimposed over a map or chart, and provides time information for system management and message time stamping.

The integrated VHF radio transceiver is used as the primary communications media for data over the ACARS network as well as for Voice communications using the ARINC AGD voice network.

The integrated sensor input (monitoring) capability is used, for example, but not limited to, monitor external to the ACARS transceiver unit, physical contacts to devices such as panic buttons, fire detection, and door contacts to provide a capability to automatically generate alerts and ACARS messages upon detection of changes of states of monitored sensor points. The ACARS messages are generated and displayed from the simplest message, such as that the aircraft has taken off from the weight sensor on landing gear to the panic button pressed by flight crew. Sensor detection may also initiate other features such as automatic position reporting and tracking as determined by the ACU program.

Fig. 4 illustrates the communication networks for the data and voice networks according to an exemplary embodiment of the systems and methods according to this invention. As shown in Fig. 4, the VHF and GPS antenna 400 connects to a data ground station 401 or a voice ground station 402. Voice communications via the ground from an aircraft may be established, for example, by phone or by IDEN, and may be established between a Sky Marshal and an aircrew member or other individual on the aircraft on which the Sky Marshal is located, or between a Sky Marshal and an aircrew member or other Sky Marshals of other selected individual on another aircraft.

Fig. 5 illustrates a communication system components according to an exemplary embodiment of the invention. The communication system is divided into three general

area. Area 20 represents the on-board network, area 30 represents the Air Marshal and area 40 represents the air crew.

Area 20, as previously shown in Fig. 2 is the communication system, specifically the on-board network having a receiver for a wireless access device 200, ACARS transceiver system 300, very high frequency (VHF) and Global Position System (GPS) antenna 400, SATCOM antenna 500, security sensor interface 600 and peripheral device 700.

Area 30 represents an Air Marshal who communicates with an on-board network while in flight by the wireless access control and display unit 100.

Area 40 represents the air crew members who communicates with the on-board network by the control and display unit 100. Further, Fig. 5 shows the ACARS transceiver 300 connected with a peripheral device 700 that is connected in area 40. The peripheral device 700 may be monitored and controlled by anyone who possesses the control and display unit 100. As shown in Fig. 5, a panic button device 800 is displayed. The panic button device 800 is a portable device typically carried at all times by the pilot and other flight crew members. The remote panic button device 800 transmits a signal to the communication system to alert that there is a situation onboard the aircraft. That is, a member of the flight crew may activate a panic button in the cockpit to transmit a signal that there is a panic situation to an operations center and/or FAMs on board the aircraft or other aircraft. The systems and methods according to this invention provides for the transmission of an Emergency Broadcast Message to the operations center and/or the FAM(s) on board this or other aircraft.

Fig. 6 illustrates the various exemplary content applications for the system according to an exemplary embodiment of the invention. For example, an aircraft passenger may use the systems and methods according to this invention for secure videoconferencing via the world wide web for viewing live television broadcasters, and for communicating with others using voice, e-mail, and facsimile communications.

An aircraft cabin crew may use the secure communications systems and methods according to this invention to communicate information regarding, for example, gate assignments, e-mail, facsimile, aircraft scheduling, cabin and/or cargo inventory, reservations, and accessing a passenger database.

An aircraft maintenance crew may use the secure communications systems and methods of this invention regarding communications with respect to aircraft performance, system diagnostics, ongoing maintenance, maintaining an electronic

logbook, maintenance documents, Flight Operations Quality Assurance (FOQA) data, Reduced Vertical Separation Monitoring (RVSM) data, and GPS information and system integrity data. The FOOA data is used by airline operations to verify and analyze the operational performance of a flight crew. FOQA data includes information regarding all aspects of a flight's performance including all system parameters and actions and control inputs made by the flight crew. The RVSM data is used to monitor the performance of aircraft navigation and position accuracy of the onboard equipment. The GPS information and system integrity data can be monitored and the system can automatically advise appropriate governmental authorities concerning the availability of GPS satellite information as well as operational performance of the GPS constellation itself.

Aircraft operations personnel may use the systems and methods according to this invention, for example, concerning aircraft weight and balance, flight weather condition information, flight planning, flight scheduling and customs clearance.

Aircraft cockpit crew members may use the systems and methods according to this invention, for example, concerning voice, weather Digital Automated Terminal Information Services (D-ATIS), Terminal Weather Information Processor (TWIP), Graphics and Text Weather Services (GTWS), and Pre Departure Clearance (PDC) communications.

Aircraft air traffic control personnel may use the systems and methods according to this information, for example, regarding position report communications and Air Traffic Control messages.

Sky Marshalls and other authorized individuals may use the systems and methods according to this invention for many communications matters, including for example, video communications, voice communications, Flight Data Recorder (black Box) information and data, CVR (Voice Recorder) information and data, flight following by military aircraft based on a panic communication, Emergency MSG and ground security and aircraft physical security information.

Flight crew can use this system in it's simplest form to only monitor the sensor input devices for automated event notification such as panic condition or wheels-off.

Flight crew can arm the system and enable automatic ACARS messages to specified entities on event of sensor detection of unauthorized door opening should the sensors be enabled when an aircraft is parked and unattended.

While this invention has been described in conjunction with the exemplary embodiments outlined above, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. For example, this invention may be used by cabin crew 2000, a maintenance crew 3000, an operations personnel 4000, a cockpit crew 5000 and ATC personnel 6000 as disclosed above.

While this invention has been described in conjunction with the exemplary embodiments outlined above, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Furthermore, although the exemplary embodiments are described for use in a variety of aircraft, it is contemplated that this invention may be used with other methods of transportsations through the land and the sea. Accordingly, the exemplary embodiments of the invention, as set forth above, are intended to be illustrative, not limiting. Various changes may be made to the invention without departing from the spirit and scope thereof.